

Discharge valve for CO<sub>2</sub> pressure cylinders  
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5 The present invention concerns a discharge valve for CO<sub>2</sub> pressure cylinders, comprising a flow passage for CO<sub>2</sub> gas, a valve element which is actuatable from the exterior and which can assume various positions and which in at least one of said positions closes the flow passage and in at least one other of said positions opens the flow passage, and connecting means for fixedly and sealingly connecting the discharge valve to a CO<sub>2</sub> pressure cylinder, wherein provided in the flow passage is a flow resistance which is independent of the valve opening which is openable by the valve element.

15 Corresponding discharge valves are known for example from US patents Nos 4 611 628 and 5 305 794. In US No 4 611 628 the additional flow resistance serves only as a switching aid for the valve, in which respect an intermediate pressure chamber which is disposed downstream of the flow resistance is initially emptied upon opening of the valve so that the valve body of which one end is in the intermediate pressure chamber is acted upon from its other end by the pressure of the pressure container and is thereby completely opened. In the case of US No 5 305 794, the arrangement has a valve connection which projects into a pressure container and which has two oppositely disposed bores which permanently provide a communication for an inner valve passage 70 to the interior of the pressure vessel. Those openings are of such dimensions that, even in 25 the event of the outer valve portion breaking off, excessively large amounts of the gas contained in the container do not issue therefrom. At the same time, also provided on the valve connection which projects into the container is a check valve which opens a larger opening cross-section when the valve is acted upon from the outside by a pressure, in order for 30 example to fill the container.

The above-indicated publications are however not concerned with the problem that the valve, instead of being acted upon by gas, could possibly also be acted upon by liquid, in which case the liquid which issues could

tend to involve very great expansion outside the cylinder or while still in the valve and could possibly also cause an explosion of external parts which are not as pressure-resistant as the pressure container.

Another known discharge valve is shown by way of example in Figure 1 of the accompanying drawings. In that case the discharge valve is a resiliently biased disk valve with an actuating nipple which projects at an end of the valve out of a recess. By pressing in the nipple, the valve disk is urged off its seat and thus opens a flow passage for CO<sub>2</sub> gas. In general terms the one end of such a discharge valve is fixedly screwed to a CO<sub>2</sub> pressure cylinder, in which case, by way of the screwthread, a collar which projects in a flange-like configuration, is pressed with an O-ring against the flat edge extending around the screwthreaded opening of a CO<sub>2</sub> pressure cylinder and thus connects the valve fixedly and sealingly to the CO<sub>2</sub> pressure cylinder. The other end is generally also screwed to an actuating device which also has a pressure-reducing device, in which respect parts on the pressure-reducing device are designed to actuate the actuating nipple of the discharge valve as soon as the pressure-reducing device is suitably set and CO<sub>2</sub> gas is to be taken from the pressure cylinder.

Furthermore, discharge valves of that kind generally also have an over-pressure safety valve which, upstream of the valve element which is actuable from the exterior, is connected to the flow passage of the discharge valve and which for example has a bursting disk which ruptures when a pressure limit value is attained in order to prevent the pressure gas bottle from exploding.

CO<sub>2</sub> pressure cylinders with corresponding discharge valves are in the meantime used relatively frequently for the production of what is known as soda water, that is to say drinking water to which carbon dioxide or CO<sub>2</sub> has been added. Increasing numbers of households have gone over to themselves producing corresponding drinking water with CO<sub>2</sub> added thereto, in colloquial speech also referred to as fizzy water or 'fizz', as that turns out to be considerably less expensive than buying bottled fizzy water as is generally commercially offered.

Special devices are provided for adding CO<sub>2</sub> to drinking water, for domestic use, in which devices on the one hand the CO<sub>2</sub> pressure cylinder is held and in which on the other hand a sufficiently pressure-resistant drinking water bottle can be accommodated, which can be connected in sealed relationship to the CO<sub>2</sub> pressure gas cylinder by way of the pressure-reducing device already mentioned above and corresponding feed conduits. As soon as a corresponding drinking water bottle has been fitted into or clamped in the device, a valve is actuated which, by way of the pressure-reducing device and the valve element of the discharge valve, provides the communication with the CO<sub>2</sub> pressure gas cylinder so that CO<sub>2</sub> gas flows into the bottle filled with drinking water, under a pressure which is typically in the range of between 2 and 10 bars, and in so doing is dissolved in the drinking water. After the drinking water has been subjected to the action of CO<sub>2</sub> gas under a suitable pressure for some seconds the valve is closed again and the drinking water bottle can be removed and thus the CO<sub>2</sub> gasified drinking water is ready for consumption. In general the drinking water bottle also has a closure in order to prevent rapid and premature degassing of the water.

So-called 'soda devices' of that kind are already in use in their millions and have proven their worth in principle. It has been found in practice however that the degree of gassing of the drinking water with CO<sub>2</sub> cannot always be kept at the same level, in spite of an identical period of actuation of the CO<sub>2</sub>-gassing valve. In particular inclined positioning of a corresponding soda device or more or less inclined fitment to the wall can also have the result that it is not always the same amount of CO<sub>2</sub> that is dissolved in the drinking water, as when a corresponding soda device is positioned upright.

Furthermore it would frequently be desirable to store or mount the soda device in an inclined or recumbent position, in which case only the drinking water bottle would have to assume a substantially vertical position, upon being removed and fitted thereto. Pivotal connecting heads for corresponding drinking water bottles are already known. For reasons of space there would be a wish now and then in particular for the

CO<sub>2</sub> pressure gas cylinder to be also disposed in a fitment position other than the usual upright position, in or on the soda device. When a recumbent position is involved however, in the case of a filled CO<sub>2</sub> pressure gas cylinder, the CO<sub>2</sub> would firstly pass into the pressure-reducing device in liquid form, in which case it admittedly evaporates and in so doing cools down but then in the general case more CO<sub>2</sub> is dissolved in the drinking water than when the CO<sub>2</sub> passes into the pressure-reducing device only in gas form so that that situation can entail a greater degree of gasification of the water than the user wishes. Admittedly the filling valves can generally be so set that they possibly vent excess CO<sub>2</sub> to the exterior and the desired gasification pressure is generally also adjustable, but nonetheless letting out excess CO<sub>2</sub> is generally undesirable.

In addition, in the case of a recumbent CO<sub>2</sub> pressure gas cylinder, differing conditions would occur in the course of gradual emptying of the pressure gas cylinder as initially only liquid CO<sub>2</sub> passes out of the bottle and into the pressure-reducing device, after a certain time a mixture of liquid and gaseous CO<sub>2</sub> would issue and finally only gaseous CO<sub>2</sub> could issue when the level of liquid has fallen sufficiently. With the varying conditions therefore the user would always have to re-set the valves in order to maintain the respective gasification pressure and degree of gasification that he wanted and in that respect to allow as little excess CO<sub>2</sub> to escape as possible.

In comparison with that state of the art, the object of the present invention is to provide a discharge valve for CO<sub>2</sub> pressure gas cylinders, which ensures always constant filling conditions if possible in any installation positions of a CO<sub>2</sub> pressure gas cylinder, so that there is no longer any need to change desired valve settings once made by the user.

That object is attained in that the flow resistance is such that at a temperature of 20°C and a CO<sub>2</sub> gas flow rate of 0.5 g/s it causes a pressure drop of at least 1 bar, preferably of more than 3 bars.

It will be appreciated that the flow rate specified herein and the pressure drop relate to CO<sub>2</sub> in the gaseous condition.

It will also be appreciated that a valve with a more or less small or large valve passage opening affords a certain flow resistance, but in accordance with the invention there is to be provided an independent flow resistance which guarantees a greater pressure drop than is possible with the usual valve element of a discharge valve and thereby prevents the passage therethrough of liquid CO<sub>2</sub>, at any event in relatively large amounts. Otherwise the nature of the configuration of the flow resistance is not subject to any limitations. It may involve an additional valve or pressure-reducing device, a plug with fine bores or other installation member, which only serves the purpose, by impeding a flow of liquid CO<sub>2</sub>, of forcing it to convert into the gaseous condition before the CO<sub>2</sub> leaves the discharge valve.

A still more preferred embodiment is one in which such a flow resistance, under the specified conditions, causes a pressure drop of more than 5 bars and preferably more than 10 bars. On the other hand however the flow resistance should also be such that, with a CO<sub>2</sub> flow rate of 0.5 g/s and at a temperature of 20°C, it does not produce a pressure drop which is greater than 50 bars, and it is better if the pressure drop is less than 40 bars and particularly preferably less than 30 bars. An excessively high pressure drop at the specified flow rate would otherwise mean that normal filling of the drinking water bottle with CO<sub>2</sub> gas, to produce a suitable fizzy water, would take a relatively long time.

A most preferred embodiment of the invention is one in which, under the specified conditions, the flow resistance produces a pressure drop of between about 12 and 15 bars.

By virtue of the high flow resistance and due to the pressure drop which is related thereto at a corresponding flow rate, liquid CO<sub>2</sub> goes into the gaseous condition on flowing through the flow resistance so that it is practically impossible for the CO<sub>2</sub> to pass through the flow resistance in liquid form.

In other words, even if the CO<sub>2</sub> pressure gas cylinder is turned upside down and in that situation the discharge valve is actuated, the flow resistance nonetheless provides that the CO<sub>2</sub> can pass through or issue

from the flow resistance only in gaseous form, thereby ensuring that CO<sub>2</sub> cannot pass into and through the pressure-reducing device in liquid form.

This ensures the desired constancy of the amount of CO<sub>2</sub> dissolved in the drinking water, under very different external operating conditions and  
5 when the CO<sub>2</sub> pressure cylinder is in any installation position.

Desirably, in addition to the flow valve, there is a check valve which in the intake direction opens a by-pass which by-passes the flow resistance but closes it in the discharge direction. As the corresponding pressure gas cylinders are generally also filled by way of the discharge valve, more  
10 specifically under a relatively high pressure of about 90 bars, using CO<sub>2</sub> in liquid form, the above-mentioned flow resistance in the discharge valve would be a severe impediment and would prolong the filling times of the CO<sub>2</sub> pressure gas cylinders by a multiple. By virtue of the fact that the arrangement has a check valve which opens in that filling direction and  
15 which permits the flow resistance to be by-passed, the filling operation is not impeded.

Desirably the check valve in question is resiliently biased in the closing direction.

The flow body can be for example a sintered body, but it is equally  
20 possible also to use a pressure-resistant diaphragm.

In the preferred embodiment the flow resistance is made from plastic material or ceramic material, for example in the form of a porous sintered body. Equally however the flow resistance could also be made from a metallic sintered body.

25 The preferred average pore size of such a sintered body or other porous material should preferably be of the order of magnitude of between 1 and 10  $\mu\text{m}$ , in which respect the porosity can be between 10% and 80%.

In an embodiment of the discharge valve according to the invention the flow resistance in the form of a porous sintered body can be a valve  
30 body which is accommodated movably in a valve seat. This 'valve' formed by a sintered body or other porous or partially permeable element would admittedly not be sealed in the closed condition but in the closed condition would still allow the passage therethrough of the quantities which can pass

through the flow body which here is in the form of a valve body, but at the same time that valve body can be moved out of its seat and thus (in the intake direction) would open a considerably larger flow cross-section whose flow resistance would be negligible. In that case therefore the flow resistance itself would form a part of a check valve. It will be appreciated that, in this case, the flow resistance which is in the form of a valve body should be biased resiliently against a valve seat in the discharge direction so that, when the valve body is acted upon from the outside, more specifically upon filling the CO<sub>2</sub> pressure cylinder, the flow resistance is urged out of its valve seat and thereby opens the by-pass for by-passing the flow resistance. Desirably, the valve body is in the form of a flow resistance with a tapered end which comes into engagement with the valve seat.

A particularly preferred embodiment of the invention is one in which the flow resistance is provided in an attachment portion which can be connected to the actual discharge valve. For example that attachment portion can be provided at one end with a male screwthread in the manner of a screw and is then screwed, in place of a closure screw, into the lower end of such a discharge valve, in which case such a conventional closure screw is generally screwed into the lower end of a through opening in the discharge valve and serves as a support for a valve spring which is arranged in that passage or flow duct and which biases the actuating valve of the discharge valve in the discharge flow direction. It will be appreciated that such a closure or support screw has a bore therethrough for CO<sub>2</sub> to pass substantially unimpededly therethrough and the attachment portion can equally also be bored therethrough and can have the above-mentioned flow resistance in that through bore.

In that respect however it may be necessary, possibly from the interior of the pressure cylinder, to make a separate communication with a bursting disk, or to provide the flow resistance only beyond a branch duct to the bursting disk in the discharge valve. It will be appreciated in that respect that it is desirable if the overall diameter of the attachment portion is smaller than the inside diameter of the screwthread of the opening in the

pressure cylinder, into which the discharge valve is screwed. In that way it is very easily possible for conventional discharge valves to be equipped with the additional component according to the invention, insofar as the bored closure screw is simply replaced by the attachment portion according to the invention, which on the one hand functions as a closure screw and forms a support for the valve spring which is provided in any case in the discharge valve, but at the same time it also includes the flow resistance which substantially prevents CO<sub>2</sub> from passing through in liquid form or so severely limits it in terms of quantity that on the side of the pressure-reducing device, there are practically always equivalent operating conditions prevailing, which without avoidable CO<sub>2</sub> losses result in a uniform degree of gasification of the fizzy water.

The present invention is directed in that respect also to the attachment portion which is to be sold separately from the discharge valve and which can be connected to a discharge valve and which includes a corresponding flow resistance.

Further advantages, features and possible uses of the present invention will be clearly apparent from the description hereinafter of a preferred embodiment and the accompanying Figures in which:

Figure 1 shows a discharge valve in accordance with the state of the art,

Figure 2 shows a first embodiment of a supplemented flow valve according to the invention with a flow resistance and a check valve additionally provided therein,

Figure 3 shows a further embodiment with a flow resistance in the form of a valve body,

Figure 4 shows an embodiment similar to Figure 3, but in which the valve body additionally has better guide means, and

Figure 5 shows a view in section taken along line V-V in Figure 4, in which it is possible to see the cross-section of the guide portion of the valve body.

Referring to Figure 1, the discharge valve 100 which is known from the state of the art comprises a valve body 1 with a flow passage 8 and an



actuating valve 10. The actuating valve 10 in turn comprises the valve disk 2, the actuating nipple 3 connected thereto, the guide portion 4 of the valve element, a valve spring 9 and a support screw 7. The support screw 7 has a bore therethrough and provides a flow passage 11 which communicates with the main flow passage 8. The guide portion 4 has either clearance, longitudinal grooves or bores, which ensure that the flow passage 8 opens a corresponding discharge cross-section for the CO<sub>2</sub> gas when the actuating nipple 3 is pressed in and the valve disk 2 is disengaged from its seat. The lower portion of the valve body 1 has a male screwthread 6 which is screwed into a corresponding female screwthread in the opening of a pressure gas bottle or cylinder. In that situation an O-ring 5 comes into engagement with a flat edge which extends around the opening of the pressure gas cylinder and is pressed firmly and sealingly on to that edge by a collar 12 provided on the valve body 1 above the O-ring 5. An over-pressure valve 20 is additionally in communication with the flow passage 8 and, when a corresponding over-pressure occurs, opens a vent opening in order to prevent the pressure gas cylinder from exploding.

Figure 2 shows a first embodiment of a discharge valve 200 modified in accordance with the invention, in which respect the modification is essentially that the support or closure screw 7 has been replaced at the lower end of the valve by an attachment portion 30 which has an attachment body 34 in which there is accommodated a porous sintered body 31 having a central bore with a check valve provided therein. The check valve 15, 16, 17 is biased in the discharge flow direction by means of a spring 17 and communicates with a corresponding valve seat within the sintered body 31. When pressure is applied from the side of the pressure gas cylinder that check valve 15, 16, 17 is closed so that CO<sub>2</sub> can only pass through the porous sintered body 31 in the flow passage 8 when the valve element 10 is actuated.

In the embodiment shown in Figure 3, the closure screw 7 of the valve 100 is also replaced by an attachment portion 30'. In this case a partially permeable check valve is formed by the body 34' of the attachment portion 30' and a sintered body 32 which is accommodated

therein and which is of a tapered configuration in the upper part. The sintered body 32 is biased by a spring in the discharge flow direction against a tapered valve seat provided in the attachment body 34', with the spring being supported against a support screw 7' having a through bore 11', similarly to the support screw 7 of the valve in the state of the art. In the discharge flow direction, the CO<sub>2</sub> has to pass through the sintered body 32 and can pass into a pressure-reducing device by way of the passage 11', 8 and the valve element 10.

In contrast, in the intake direction, the pressure of the inflowing CO<sub>2</sub> gas or the CO<sub>2</sub> in liquid form provides that the porous sintered body 32 is urged away from its valve seat so that the CO<sub>2</sub> can flow into the pressure gas cylinder past the sintered body 32.

The embodiment shown in Figure 4 is very similar to that shown in Figure 3, except that in this case the lower portion of the porous sintered body 33 is of a substantially cylindrical configuration, of an outside diameter which substantially corresponds to the inside diameter of the body 34" in its lower part, so that as a result the porous sintered body 33 has good guidance and cannot tilt. For the purposes of allowing the CO<sub>2</sub> gas or the CO<sub>2</sub> in liquid form to pass therethrough in the operation of filling a pressure gas cylinder, provided in the cylindrical guide portion of the sintered body 33 are grooves 35 extending in the longitudinal direction so that, when the sintered body 33 is pushed back against the spring 9' in the operation of filling the pressure cylinder and as a result a passage is opened between the tapered valve seat and the tapered portion of the sintered body, the CO<sub>2</sub> can also flow into the pressure gas cylinder, past the cylindrical portion, through the longitudinally extending grooves 35.

The cross-section of that cylindrical portion with the two grooves 35 can be clearly seen in Figure 5.